

INSECTS ASSOCIATED WITH PURPLE LOOSESTRIFE  
(*LYTHRUM SALICARIA* L.) IN EUROPE

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*Abstract.*—In Europe, 120 species of phytophagous insects, including 14 species apparently restricted to *Lythrum*, and 64 species of floral visitors were found associated with purple loosestrife, *L. salicaria* L. Of potential value for the biological control of this aggressive alien weed in North American wetlands are: *Dasineura salicariae* (Cecidomyiidae); *Hylobius transversovittatus*, *Nanophyes marmoratus*, *N. brevis* (Curculionidae); *Pyrrhalta californiensis*, *P. pusilla*, *Aphthona lutescens*, *Altica lythri* (Chrysomelidae); and *Acleris lorquiniana* (Tortricidae). Ecological, bionomic, and host-specificity investigations of these natural enemies are needed.

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Purple loosestrife, *Lythrum salicaria* L. (Lythraceae), is considered by some ecologists to be a menace to our North American wetlands because it displaces native wildlife foods such as cattails (*Typha* spp.). Control by chemical or mechanical methods is difficult and usually not practical for large, well-established stands (Stuckey, 1980). For these reasons, and because biological control is compatible with wildlife conservation and management in wetlands, a search for natural enemies of purple loosestrife in Europe was undertaken. However, because ornamental purple loosestrife is widely cultivated, garden escapes are common (Stuckey, 1980), and beekeepers may propagate it as a nectar source (Pellett, 1966). These uses pose conflicts of interest regarding the feasibility of biological control.

This tall, vigorous, herbaceous perennial is native to Eurasia and usually found in freshwater wetland habitats (Hultén, 1971; Stuckey, 1980). In mid- to late summer, it bears three types of self-incompatible, insect-pollinated, vivid magenta flowers that are densely packed throughout conspicuous vertical verticillate spikes (Levin and Kerster, 1973; Teale, 1982). Each plant may bear as many as 3000 flowers, yielding 300,000 seeds; a pure stand of purple loosestrife may thus produce up to 59 billion seeds per hectare (24 billion/acre; Teale, 1982).

In Europe, purple loosestrife may occasionally form dense monospecific stands, on calcareous or acid soils (Shamsi and Whitehead, 1974), but it usually occurs as a minor component (1-4% of cover) of mixed wetland vegetation (Bodrogkozy

and Horvath, 1977). In North America, purple loosestrife was first recorded from New England and southeastern Canada in 1814 (Stuckey, 1980). Subsequently it spread to 33 states, with the largest populations in the formerly glaciated portions of the northeastern and Great Lakes states (Stuckey, 1980). The minute seeds of this aggressive plant are usually water-borne, but they may be disseminated by wildlife and livestock. Plants can also regenerate from stem or rootstock fragments.

#### MATERIALS AND METHODS

Field surveys for insects were made in July–August 1979 (Batra); September–November 1980 (Boldt); and May–August 1981 (Mendl, Batra) at 13 sites in Emilia Romagna, Lombardia, Umbria, Calabria, Sicilia, Sardegna, Piemonte, Veneto and Lazio, Italy; 15 sites in Steiermark, Burgenland, and Niederosterreich, Austria; 1 site in Buskerud, Norway; 1 site in Kalmar, Sweden; and 2 sites in Croatia, Yugoslavia; some of these sites were visited repeatedly during several months. At most locations, the plants grew as scattered individuals or small clumps among mixed wetland vegetation; occasional plants also grew in dry meadows. Insects on the plants were observed, then hand-picked, aspirated, or netted and any feeding damage was noted. Living insects and immatures were placed on caged bouquets of cut stems, leaves, and flowers to assess feeding habits; immatures were reared to adulthood, when possible. Large quantities of cut or uprooted plants were bagged and brought to the laboratory and either dissected to reveal internal feeders, or caged for several weeks for the transformation and emergence of these and other cryptic insects.

#### RESULTS AND DISCUSSION

In Europe, 120 species of phytophagous insects were found, including 14 probably restricted to *Lythrum* spp. (Table 1); 64 species of flower visitors were also collected from purple loosestrife (Table 2). Only a few of the phytophagous species are sufficiently host-specific to be worthy of further consideration and testing for use in classical biological control (Batra, 1982).

The most promising for testing include several species of *Nanophyes* weevils that attack only *Lythrum* species, e.g. *N. annulatus* and *N. circumscriptus* galling leaves, petioles and stems, *N. globiformis* and *N. helveticus* galling stems; *N. marmoratus* and *N. brevis* mining ovaries and seeds. *Nanophyes brevis*, *N. helveticus*, and *N. circumscriptus* are restricted to *L. salicaria*, according to Dieckmann (1963). Furthermore, *N. circumscriptus* tolerates a cold climate (Kontuniemi, 1943) such as would be encountered where purple loosestrife is most abundant in North America. A related species, *Nanophyes* sp. nr. *nigritulus* attacks fruits of the aquatic weed, *Jussiaea repens*, and has been considered for use in biological control (Sankaran and Krishna, 1967). We found during our surveys that univoltine *N. marmoratus* (Fig. 2) is by far the most abundant and widespread of the genus, and it is one of the more common of all phytophages on *L. salicaria*. This weevil destroyed up to 69% of the ovules of some plants.

The multivoltine chrysomelids, *Pyrrhalta calmariensis* (Fig. 3) and *P. pusilla* appear to be specific to *Lythrum* and are patchily abundant in Italy, Austria, and Yugoslavia, where dense populations on some plants cause significant (ca. 50%) defoliation. There are four generations of *P. calmariensis* annually in northern Italy (Zocchi, 1953).

Table 1. Phytophagous insects associated with *Lythrum salicaria*. Legend: L, leaves; St, stems; R, roots or rhizomes; F, flowers; S, seeds. \* Indicates species of greatest apparent host-specificity and potential as agents for classical biological control in North America.

Taxon	Location	Plant Part	Recorder/Remarks
<b>Coleoptera</b>			
<b>Cantharidae</b>			
<i>Rhagonycha fulva</i> (Scopoli)	E. Austria	L	Batra
<b>Chrysomelidae</b>			
<i>Altica ampelophaga</i> Guérin	N. Italy, E. Austria	L	Boldt; Mendl; <i>Epilobium</i> usual host, Freude et al., 1966; Phillips, 1977
<i>Altica impressicollis</i> Reiche	Sardinia, Sicily	L	Boldt
* <i>Altica lythri</i> Aubé	N. Italy	L	Boldt
<i>Altica oleracea</i> (L.)	S. Italy	L	Boldt
<i>Altica palustris</i> Weise	E. Austria	L	Mendl; <i>Epilobium</i> usual host, Freude et al., 1966
* <i>Aphthona lutescens</i> (Gyllenhal)	E. Austria, N. Italy	R, L	Batra; Boldt; Freude et al., 1966
<i>Chrysolina herbacea menthastri</i> Suffrian	Italy	L	Boldt
<i>Cryptocephalus ocellatus</i> Drapiez	E. Austria, N. Yugoslavia	L	Batra, reared
<i>Dlochrysa fastusa</i> (Scopoli)	Italy	L	Boldt
Galerucine sp.	Austria	L	Batra, reared
<i>Longitarsus</i> nr. <i>luridus</i> (Scopoli)	E. Austria	L	Batra
<i>Longitarsus tabidus</i> (F.)	N. Yugoslavia	L	Batra
* <i>Lythrarina salicariae</i> (Paykull)	Italy	L	Boldt
<i>Oulema melanopus</i> (L.)	N. Italy	L	Batra, pest of cereals
<i>Phyllotreta</i> sp.	N. Yugoslavia	L	Batra
<i>Phyllotreta vittata</i> (F.)	N. Yugoslavia	L	Batra
<i>Phyllotreta vittula</i> Redtenbacher	E. Austria, N. Yugoslavia	R	Batra, pest of cereals
<i>Psylliodes picina</i> (Marsh)	Europe	L, S	Balachowsky, 1963
* <i>Pyrhalta calvariensis</i> (L.)	N. Italy, E. Austria	L, F	Batra, reared; Boldt; Mendl; Freude et al., 1966; Hering, 1957, Zocchi, 1953, abundant
* <i>Pyrhalta pusilla</i> (Duftschmidt)	N. Italy, E. Austria, N. Yugoslavia	L, mines	Batra; Freude et al., 1966; Hering, 1957, Boldt
<b>Curculionidae</b>			
<i>Anthonomus rubi</i> (Herbst)	N. Austria, S. Sweden, N. Italy	L, F	Batra; Boldt, pest of Rosaceae
<i>Apion sanguineum</i> (DeGeer)	N. Yugoslavia	L	Batra; <i>Lythrum</i> prob. not host
<i>Apoderus erythropterus</i> Zschach	Europe	L	Hoffmann, 1954; polyphagous
* <i>Hylobius transversovittatus</i> (Goeze)	Italy, E. Austria	R, St	Boldt; Mendl; Hoffmann, 1954; Scherf, 1964

Table 1. Continued.

Taxon	Location	Plant Part	Recorder/Remarks
<i>Lixus iridus</i> Olivier	Italy	St	Boldt, polyphagous
* <i>Nanophyes annulatus</i> Arag.	W. Europe, N. Yugoslavia	L galls	Batra, reared; Hoffmann, 1958; Dieckmann, 1963
* <i>Nanophyes brevis</i> Boheman	E. Austria, S. Europe	S, F	Mendl; Hoffmann, 1958
* <i>Nanophyes circumscriptus</i> Aubé	N. & C. Europe	St, L galls	Hoffmann, 1958; Dieckmann, 1963; Buhr, 1964
* <i>Nanophyes globiformis</i> (Kiesenwetter)	S. & C. Europe	St galls	Dieckmann, 1963
* <i>Nanophyes helveticus</i> Tournier	S. & C. Europe	St galls	Dieckmann, 1963
<i>N. hemisphaericus</i> Olivier	C. Europe	St	Hoffmann, 1958; Buhr, 1964
<i>Nanophyes marmoratus</i> (Goeze)	N. Yugoslavia, S. Sweden, Italy, E. Austria, Europe	F, S	Batra, reared; Boldt; Mendl; Hoffmann, 1958; Scherf, 1964; very common
<i>Nanophyes nitidulus</i> Gyllenhal	S. & C. Europe, N. Africa	St galls	Hoffmann, 1958; Dieckmann, 1963; usually on <i>L. hyssopifolia</i>
<i>Nanophyes yvonnae</i> Hoffmann	W. Europe	?	Hoffmann, 1958
<i>Phytobius comari</i> (Herbst)	Europe	L	polyphagous, Hoffmann, 1954; Scherf, 1964
Elateridae			
<i>Adrastus rachifer</i> (Fourcroy)	E. Austria	L	Batra; biology unknown
<i>Silesis</i> sp.	N. Yugoslavia	L	Batra
Helodidae			
<i>Cyphon</i> sp.	E. Austria	L	Batra
Melyridae			
<i>Malachius</i> , prob. <i>bipustulatus</i> (L.)	N. Yugoslavia	L	Batra
Collembola			
Entomobryidae			
<i>Deuterosminthurus repandus</i> Agren	E. Austria	L	Batra
<i>Entomobrya nivalis</i> L.	E. Austria, S. Sweden	L, St	Batra
<i>Lepidocepus pusillus</i> L.	E. Austria	L, St	Batra
<i>Tomocerus</i> sp.	S. Sweden	L, St	Batra
Diptera			
Cecidomyiidae			
* <i>Dasineura salicariae</i> (Kieffer)	E. Austria, N. Yugoslavia, N. Europe, S. Italy	St bud galls	Batra, reared; Boldt, Buhr, 1964
Hemiptera			
Berytidae			
<i>Metacanthus meridionalis</i> (Costa)	Europe	L ?	Wheeler and Schaefer, 1982

Table 1. Continued.

Taxon	Location	Plant Part	Recorder/Remarks
<b>Coreiidae</b>			
<i>Syromastes marginatus</i> (L.)	E. Austria	L	Batra
<b>Lygaeidae</b>			
<i>Cymus melanocephalus</i> (Fieber)	N. Yugoslavia	L	Batra
<i>Cymus</i> sp.	E. Austria	L	Batra
<i>Nysius</i> nr. <i>ericae</i> Schilling	Italy	L, F	Boldt
<b>Miridae</b>			
<i>Adelphocoris lineolatus</i> (Goeze)	N. Yugoslavia, Ita- ly	L, F	Batra; Boldt; polyphagous, also in U.S.
<i>Adelphocoris seticornis</i> (F.)	N. Yugoslavia	L	Batra, usual hosts Legu- minosae
<i>Campylomma verbasci</i> (Meyer-Dür)	E. Austria	L	Batra, polyphagous
<i>Calocoris roseomaculatus</i> (DeGeer)	N. Yugoslavia	L	Batra, usual hosts Astera- ceae
<i>Liocoris tripustulatus</i> (F.)	N. Yugoslavia	L	Batra, usual hosts nettles
<i>Lygus</i> sp.	Italy, E. Austria	L, F	Boldt; Mendl
<i>Lygus pratensis</i> (L.)	N. Yugoslavia	L	Batra, polyphagous
<i>Lygus rugulipennis</i> Pop- pius	N. Yugoslavia, E. Austria	L	Batra, polyphagous
Mirinae spp. nymphs	N. Yugoslavia	L, F	Batra
Orthotylinae sp.	N. Yugoslavia	L	Batra
<i>Plagiognathus alpinus</i> Reuter	N. Yugoslavia	L	Batra
<i>Plagiognathus arbustorum</i> (F.)	S. Sweden, E. Aus- tria, N. Yugosla- via	L	Batra, polyphagous
<i>Plagiognathus chrysan- themii</i> (Wolff)	E. Austria, S. Swe- den	L, F	Batra, usual hosts Astera- ceae
<i>Stenodema calcaratum</i> (Fallén)	E. Austria	L	Batra, usual hosts grasses
<i>Stenodema laevigatum</i> (L.)	N. Yugoslavia	L	Batra, usual hosts grasses
<b>Pentatomidae</b>			
<i>Carpocoris pudicus</i> (Poda)	N. Yugoslavia	L	Batra
<i>Dolycoris baccarum</i> (L.)	E. Austria	L	Batra, polyphagous
<i>Eysarcoris</i> nr. <i>inconspic- uus</i> (Herrich-Schäffer)	Sardinia	L	Boldt
<i>Holcostethus</i> sp.	Italy	L	Boldt
<b>Homoptera</b>			
<b>Aphididae</b>			
<i>Aphis fabae</i> Scopoli	E. Austria, Europe	L	Mendl; Buhr, 1964
<i>Aphis gossypii</i> Glover	S. Italy	L	Boldt
<i>Aphis salicariae</i> Koch	Europe	L	Patch, 1938
<i>Myzus lythri</i> (Schrank)	Italy, Sardinia, N. Yugoslavia, E. Austria	L	Batra; Boldt, abundant
<b>Cercopidae</b>			
<i>Aphrophora alni</i> (Fallén)	E. Austria	L	Batra
<i>Cercopis sanguinolenta</i> (Scopoli)	S. Italy	L, F, S	Boldt

Table 1. Continued.

Taxon	Location	Plant Part	Recorder/Remarks
<i>Lepyronia coleoptrata</i> (L.)	N. Yugoslavia	L, S	Batra
<i>Philaenus spumarius</i> (L.)	S. Italy, N. Yugoslavia, E. Austria	L, F, S	Batra; Boldt, polyphagous pest
Cicadellidae			
<i>Cicadella viridis</i> (L.)	Italy, N. Yugoslavia	L	Batra; Boldt
<i>Empoasca</i> ( <i>Kybos</i> ) <i>butleri</i> Edwards	N. Yugoslavia	L	Batra
<i>Empoasca decipiens</i> Paoli	N. Yugoslavia	L	Batra
<i>Empoasca</i> sp.	S. Italy	L	Boldt
<i>Mocuellus metrius</i> (Flor)	E. Austria	L	Batra
<i>Typhlocyba</i> sp.	S. Sweden	L	Batra
Coccidae			
<i>Ceroplastes sinensis</i> Del Guercio	Italy	L	Boldt
Delphacidae			
Delphacid nymph	E. Austria	L	Batra
Membracidae			
<i>Stictocephala bisonia</i> Kopp & Yonke	E. Austria	L	Batra, pest
Pseudococcidae			
<i>Pseudococcus affinis</i> (Maskell)	S. Italy	L	Boldt
Tettigometridae			
<i>Tettigometra</i> sp.	Sardinia	L	Boldt
Hymenoptera			
Tenthredinidae			
<i>Ametastegia glabrata</i> (Fallén)	E. Austria	L	Batra; Mendl; polyphagous, also in N. America
Lepidoptera			
Arctiidae sp.	Yugoslavia	L	Batra
Coleophoridae			
<i>Coleophora paripennella</i> Zeller	Europe	L	Hering, 1957, polyphagous
Gelechiidae			
<i>Monochroa</i> ( <i>Xystophora</i> ) <i>conspersella</i> (Herrich-Schäffer)	Europe	L	Hering, 1957
Geometridae			
Geometrid spp.	N. Yugoslavia	L	Batra
<i>Chloroclystis v-ata</i> Haworth	E. Austria, Europe	L	Mendl; Hering, 1957; Elmquist, 1978; polyphagous
<i>Ematurga atomaria</i> (L.)	N. Yugoslavia	L	Batra, reared
<i>Eupithica</i> spp.	Italy, S. Sweden	L, F	Batra; Boldt, abundant
Gracillariidae			
<i>Calybites phasianipennella</i> (Hübner)	Europe	L	Hering, 1957
Noctuidae			
Noctuid spp.	N. Yugoslavia, E. Austria	L	Batra



Table 1. Continued.

Taxon	Location	Plant Part	Recorder/Remarks
<i>Caloptusia</i> sp.	S. Sweden	St	Batra
<i>Polia oleracea</i> L.	E. Austria	L	Mendl
Psychidae			
<i>Apterona paludella</i> Dun- nehl	Europe	L	Hering, 1957
Sphingidae			
<i>Deilephila elpenor</i> L.	E. Austria	L	Mendl, polyphagous
<i>Deilephila</i> prob. <i>porcellus</i> L.	E. Austria	L	Batra, reared
Tortricidae			
Tortricid spp.	E. Austria, N. Italy, N. Yugoslavia	L	Batra
Olethreutinae sp.	N. Yugoslavia	L	Batra, reared
<i>Acleris</i> sp.	E. Austria	L	Batra
* <i>Acleris lorquiniana</i> Du- ponchel	N. Europe	F	Hannemann, 1961
<i>Syndemis musculana</i> (Hübner)	N. Europe	L	Hannemann, 1961
Lycaenidae			
Lycaenid sp.	N. Italy, N. Yugo- slavia	L	Batra
<i>Syntarucus pirthous</i> (L.)	S. Italy	F	Boldt, abundant
Orthoptera			
Acrididae			
<i>Odontopodisma schmidti</i> (Fieber)	N. Yugoslavia	L	Batra
Tettigoniidae			
<i>Conocephalus</i> sp.	N. Yugoslavia	L	Batra
<i>Phaneroptera nana nana</i> Fieber	N. Yugoslavia	L	Batra
Psocoptera			
Amphilpsocidae			
<i>Graphopsocus cruciatus</i> L.	N. Yugoslavia	L	Batra
Lachesillidae			
<i>Lachesilla pedicularia</i> (L.)	E. Austria	L	Batra
Thysanoptera			
Thysanoptera spp.	Europe	L, F, St	Batra; Boldt
Thripidae			
<i>Taeniothrips discolor</i> (Karny)	Europe	F	Priesner, 1928, polypha- gous
<i>Thrips</i> sp.	E. Austria	F	Mendl
<i>Thrips discolor</i> (Karny)	Europe	F	Priesner, 1928, polypha- gous

The cecidomyiid, *Dasineura salicariae* (Fig. 1), is widespread in the cool climates of northern and central Europe and is specific to *L. salicaria* (Buhr, 1964). It forms galls in the apical and axillary meristems, which effectively prevent flowering and branching. In some locations we found that all axillary buds of some plants were galled and aborted. These galls can reduce foliage production by 75%, and reduce growth of flowering spikes and thus seed production by 80%.

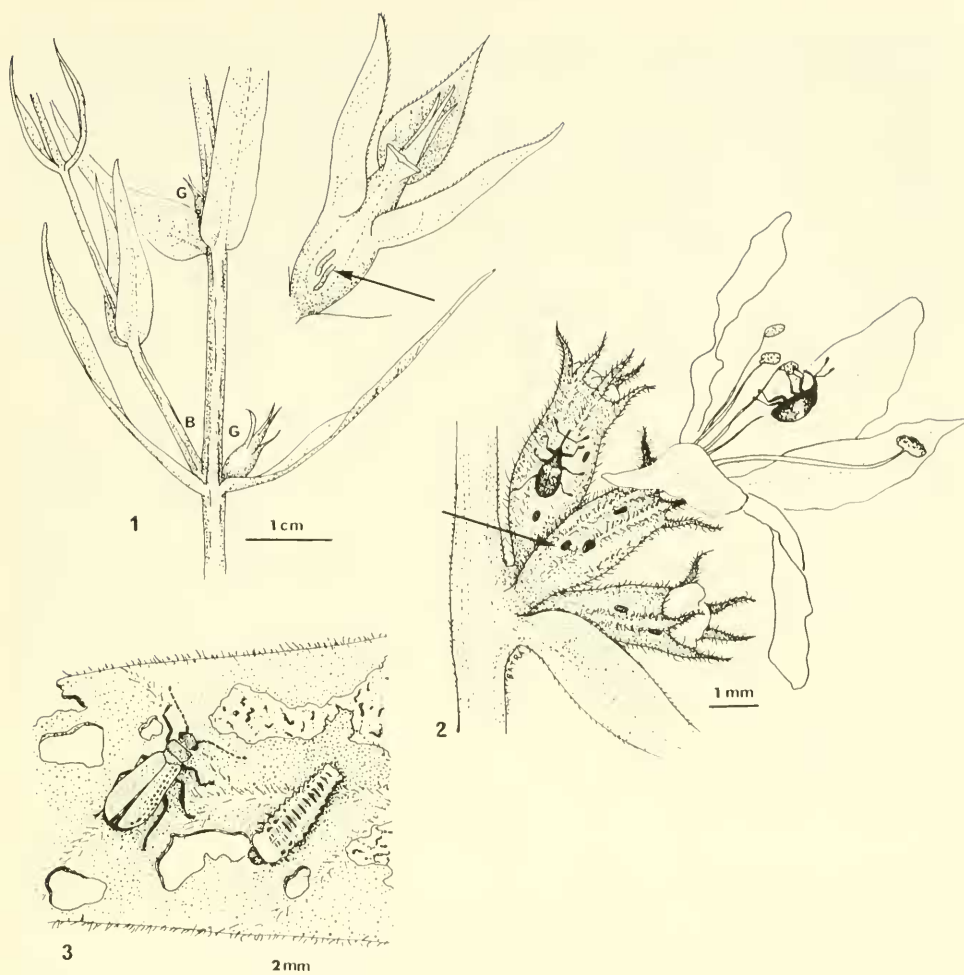
Table 2. Floral visitors of *Lythrum salicaria*.

Taxon	Location	Recorder/Remarks
<b>Coleoptera</b>		
<b>Mordellidae</b>		
<i>Mordella</i> sp.	N. Italy	Boldt
<b>Nitidulidae</b>		
<i>Brachyterolus pulicarius</i> (L.)	N. Yugoslavia	Batra
<i>Epuraea</i> sp.	E. Austria	Batra, larvae damage flowers
<i>Meligethes</i> 2 spp.	E. Austria, N. Yugoslavia	Batra, larvae damage flowers
<b>Oedemeridae</b>		
<i>Oedemera subulata</i> (Olivier)	N. Yugoslavia	Batra
<b>Orthoperidae</b>		
<i>Sericoderus</i> sp.	N. Italy	Batra
<b>Phalacridae</b>		
<i>Olibrus</i> sp.	N. Yugoslavia	Batra; Asteraceae usual hosts
<b>Diptera</b>		
<b>Anthomyiidae</b>		
<i>Delia platura</i> Meigen	E. Austria	Batra
<b>Calliphoridae</b>		
<i>Pollenia</i> sp.	E. Austria	Batra
<b>Ceratopogonidae</b>		
<i>Forcipomyia (Thyridomyia)</i> sp.	E. Austria	Batra
<b>Chironomidae</b>		
Chironomid sp.	E. Austria	Batra
<b>Chloropidae</b>		
<i>Meromyza</i> sp.	E. Austria	Batra
<i>Tricimba cincta</i> (Meigen)	N. Italy, N. Yugoslavia, E. Austria	Batra
<b>Dolichopodidae</b>		
<i>Chrysotus</i> sp.	N. Yugoslavia	Batra
<b>Empididae</b>		
Empidid sp.	E. Austria	Batra
<b>Muscidae</b>		
<i>Coenosia</i> nr. <i>antennata</i> Wiedemann	N. Yugoslavia	Batra
<b>Scatopsidae</b>		
<i>Scatopse</i> sp.	E. Austria	Batra
<b>Sciaridae</b>		
<i>Bradysia</i> spp.	E. Austria	Batra
<i>Sciara</i> sp.	E. Austria	Batra
<b>Simuliidae</b>		
<i>Simulium</i> sp.	E. Austria	Batra
<b>Syrphidae</b>		
<i>Episyrphus balteatus</i> (DeGeer)	E. Austria, Sardinia	Batra; Boldt
<i>Eristalis tenax</i> (L.)	E. Austria	Batra
<i>Helophilus pendulus</i> (L.)	E. Austria	Batra
<i>Neoascia podagrica</i> (F.)	N. Yugoslavia	Batra
<i>Platycheirus pelatutus</i> (Meigen)	E. Austria	Batra
<i>Platycheirus</i> sp.	N. Yugoslavia	Batra
<i>Scaeva pyrastris</i> (L.)	E. Austria	Batra
<i>Sphaerophoria</i> spp.	E. Austria, N. Yugoslavia	Batra
<i>Syritta pipiens</i> (L.)	N. Yugoslavia	Batra
Syrphid sp.	E. Austria	Batra



Table 2. Continued.

Taxon	Location	Recorder/Remarks;
<b>Hemiptera</b>		
<b>Anthocoridae</b>		
<i>Anthocoris nemorum</i> (L.)	E. Austria	Batra
<i>Anthocoris pilosus</i> (Jakovelev)	N. Yugoslavia	Batra
<i>Orius majusculus</i> (Reuter)	E. Austria, N. Yugoslavia	Batra
<i>Orius minutus</i> (L.)	E. Austria, N. Yugoslavia, Italy, Sicily	Batra, reared; Boldt, abundant
<i>Orius niger</i> (Wolff)	Italy, N. Yugoslavia, E. Austria	Batra, reared; Boldt
<b>Hymenoptera</b>		
<b>Apidae</b>		
<i>Apis mellifera</i> L.	N. Yugoslavia	Batra
<i>Bombus lapidarius</i> (L.)	N. Yugoslavia	Batra
<i>Bombus lucorum</i> (L.)	Poland, N. Yugoslavia	Batra; Banaszak, 1973
<i>Bombus pascuorum</i> (Scopoli)	Poland	Banaszak, 1973
<i>Psithyrus</i> sp.	N. Yugoslavia	Batra
<b>Anthophoridae</b>		
<i>Ceratina callosa</i> (F.)	USSR	Pesenko, 1974
<i>Ceratina cyanea</i> (Kirby)	Poland	Banaszak, 1973
<i>Nomada emarginata</i> Morawitz	USSR	Pesenko, 1974
<i>Tetralonia nana</i> Morawitz	USSR, N. Yugoslavia	Batra, Pesenko, 1974
<i>Tetralonia salicariae</i> (Lepeletier)	USSR, Hungary	Pesenko, 1974; Tanacs, 1978
<i>Triepeolus tristis</i> Smith	USSR	Pesenko, 1974
<b>Bethylidae</b>		
<i>Goniozus</i> sp.	N. Italy	Batra
<b>Chalcididae</b>		
<i>Chalcis</i> sp.	E. Austria	Batra
<b>Eulophidae</b>		
<i>Tetrastichus</i> sp.	E. Austria, N. Italy	Batra
<b>Formicidae</b>		
<i>Dolichoderus quadripunctatus</i> (L.)	N. Italy	Batra
<i>Myrmica rubra</i> (L.)	E. Austria	Batra
<i>Plagiolepis pygmaea</i> (Latreille)	N. Italy	Batra
<b>Halictidae</b>		
<i>Evyllaenus</i> sp.	N. Yugoslavia	Batra
<b>Ichneumonidae</b>		
<i>Ichneumon</i> spp.	E. Austria	Batra
<b>Megachilidae</b>		
<i>Anthidium florentinum</i> F.	N. Yugoslavia	Batra
<i>Megachile</i> sp.	N. Yugoslavia	Batra
<i>Megachile circumcincta</i> (K.)	Poland	Banaszak, 1973
<b>Melittidae</b>		
<i>Melitta haemorroidalis</i> (F.)	N. Yugoslavia	Batra, abundant
<i>Melitta nigricans</i> Alfken	Poland, Hungary	Banaszak, 1973; Tanacs, 1978
<i>Proctotrupoidea</i> sp.	E. Austria	Batra
<b>Scelionidae</b>		
<i>Telenomus</i> sp.	N. Italy	Batra
<b>Tenthredinidae</b>		
<i>Athalia rosae</i> (L.)	E. Austria	Batra, adult; larvae on Cruciferae
<i>Macrophya crassula</i> (Klug)	N. Yugoslavia	Batra, adult on <i>Sambucus</i>
<b>Lepidoptera</b>		
<i>Zygaenid</i> sp.	N. Yugoslavia	Batra



Figs. 1-3. Natural enemies of purple loosestrife in Europe. 1, Axillary galls (G) of *Dasineura salicariae*, which have prevented side branching (B) and growth of photosynthetic tissue and flower spikes. 1, Axillary gall of *D. salicariae* showing larvae in central chamber (arrow). 2, *Nanophyes marmoratus* on flowers, with characteristic holes (arrow), indicating damaged ovules. 3, *Pyrrhalta californiensis* adult and larva on foliage, with characteristic feeding marks.

Most *D. salicariae* galls were occupied by parasitic wasps, which must not be introduced into North America.

Other insects that are host-specific, according to the literature (Table 1), and may be useful for biological control, are the uncommon univoltine stem and root-boring weevil *Hylobius transversovittatus*, the defoliating chrysomelids *Aphthona lutescens* and *Altica lythri*, and the multivoltine flower-destroying tortricid, *Acleris lorquiniana*.

We recommend that detailed ecological and host-specificity studies be initiated for *D. salicariae*, *H. transversovittatus*, *P. californiensis* and *P. pusilla*, which attack the photosynthetic tissue and supporting structures of existing plants, and for *N. marmoratus* and *N. brevis*, which destroy the profuse seeds.

In North America (Levin and Kerster, 1973; Teale, 1982), as well as in Europe

(Table 2) the open flowers of purple loosestrife are a rich nectar and pollen resource for a wide variety of beneficial insects including pollinating bees, adult parasitic wasps, and syrphid flies, as well as adults of phytophagous and saprophagous insects. For example, in the U.S. (Franklin Co., N.Y.), SWTB found that the flowers are visited by numerous male and worker bumble bees (*Bombus bimaculatus* Cresson, *B. pennsylvanicus* (DeGeer), *B. ternarius* Say, *B. vagans* Smith, and *B. perplexus* (Cresson)), other bees (*Megachile melanophaea* Smith, *M. mendica* Cresson, *Anthophora furcata* Cresson, *Evyllaenus leucozonius* (Schrank), *Dialictus versatus* (Robertson), *D. admirandus* (Sandhouse) and *Halictus confusus* (Smith)), butterflies (*Polites* sp.) and syrphid flies. The effects of large stands of flowering purple loosestrife on insect populations and insectivores in our wetlands are unknown, but may be significant.

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#### LITERATURE CITED

- Banaszak, J. 1973. Hymenoptera Apoidea of the surroundings of Poznan. *Badania Fizjograficzne Polska Zachodnia* 26 (Ser. B): 33-78.
- Batra, S. W. T. 1982. Biological control in agroecosystems. *Science* 215: 134-139.
- Bodrogkozy, G. and I. Horvath. 1977. Connection between stand pattern and the organic-matter production in the marshlands of the inundation area at Körtvelyes. *Tiscia (Szeged)* 12: 65-70.
- Buhr, H. 1964. Bestimmungstabellen der Gallen (Zoo- und Phytocecidien) an Pflanzen Mittel- u. Nordeuropas. Fischer, Jena, 2 vols., 1572 pp., 25 pls.
- Dieckmann, L. 1963. Die mitteleuropäischen Arten der Gattung *Nanophyes* Schönh. nebst einer neuen Art aus Bulgarien. *Reichenbachia* 1: 169-194.
- Elmqvist, H. 1978. Det svenska fyndet av *Chloroclystis r-ata* Hw. (Lep. Geometridae). *Entomol. Tidskr.* 99: 109-110.
- Freude, H., K. W. Harde, and G. A. Lohse. 1966. Die Käfer Mitteleuropas, Vol. 9, Cerambycidae and Chrysomelidae. Goecke & Evers, Krefeld, 350 pp.
- Hannemann, H. J. 1961. Die Wickler (s.str. Tortricidae) 28, Teil, Kleinschmetterlinge oder Microlepidoptera. *In* Die Tierwelt Deutschlands und der angrenzenden Meeresteile. Fischer, Jena, 233 pp.
- Hering, E. M. 1957. Bestimmungstabellen der Blattminnen von Europa. Dr. W. Junk, 'S-Gravenhage, 1185 pp.
- Hoffmann, A. 1954. Coléoptères Curculionidae (deuxième partie), pp. 487-1208. *In* Faune de France, Vol. 59. Lechevalier, Paris.
- . 1958. Coléoptères Curculionides (troisième partie), pp. 1209-1839. *In* Faune de France, Vol. 62. Lechevalier, Paris.
- Hultén, E. 1971. The circumpolar plants. II, Dicotyledons. *Sv. Vet. Akad. Handl.* 13(1): 1-463.
- Kontuniemi, T. 1943. *Nanophyes circumscriptus* Aubé (Col., Curculionidae) akämän aiheuttajana. *Ann. Entomol. Fenn.* 9: 212-214.

- Levin, D. A. and M. W. Kerster. 1973. Assortative pollination for stature in *Lythrum salicaria*. *Evolution* 27: 144-152.
- Patch, E. M. 1938. Food-plant catalogue of the aphids of the world, including the Phylloxeridae. *Maine Agric. Exp. Sta. Bull.* 393: 431 pp.
- Pellett, M. 1966. Purple loosestrife, colorful honey plant. *Am. Bee J.* 106: 134-135.
- Pesenko, Y. A. 1974. On the fauna and ecology of Apoidea (Hymenoptera) of the lower Don. IV. The family Anthophoridae. *Entomol. Rev.* 2: 60-68.
- Phillips, W. M. 1977. Modification of feeding 'preference' in the flea-beetle, *Haltica lythri* (Coleoptera, Chrysomelidae). *Entomol. Exp. Appl.* 21: 71-80.
- Priesner, H. 1928. *Die Thysanopteren Europas*. Wagner, Wien. 755 pp.
- Sankaran, T. and K. Krishna. 1967. The biology of *Nanophyes* sp. (Col., Curculionidae) infesting *Jussiaea repens* in India. *Bull. Entomol. Res.* 57: 337-341.
- Scherf, H. 1964. Die Entwicklungsstadien der mitteleuropäischen Curculioniden (Morphologie, Biologie, Ökologie). *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, Nr. 506. 335 pp.
- Shamsi, S. R. I. and F. H. Whitehead. 1974. Comparative eco-physiology of *Epilobium hirsutum* L. and *Lythrum salicaria* L. *J. Ecol.* 62: 279-290.
- Stuckey, R. L. 1980. Distributional history of *Lythrum salicaria* (purple loosestrife) in North America. *Bartonia* 47: 3-20.
- Tanaes, L. 1978. Contributions to the dominance and abundance relations of the Apoidea living in the flood-plain and on the dams of the Tisza. *Tiseia (Szeged)* 13: 185-186.
- Teale, E. W. 1982. Stems beyond counting, flowers unnumbered. *Audubon* 84: 38-43.
- Wheeler, A. G., Jr. and C. W. Schaefer. 1982. Review of stilt bug (Hemiptera: Berytidae) host plants. *Ann. Entomol. Soc. Am.* 75: 498-506.
- Zocchi, R. 1953. Contributo alla conoscenza della *Galerucella calmarientis* L. (Coleoptera, Chrysomelidae). *Redia* 38: 255-280.